Entergy

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Mike Bellamy
Site Vice President

April 17, 2003

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Subject: Entergy Nuclear Operations, Inc.
Pilgrim Nuclear Power Station
Docket No. 50-293
License No. DPR-35

Licensee Event Report 2003-001-00

Letter Number: 2.03.043

Dear Sir:

The enclosed Licensee Event Report (LER) 2003-001-00, "Manual Scram and Completion of a Required Shutdown due to Recirculation Motor-Generator Trip and Runback," is submitted in accordance with 10 CFR 50.73.

This letter contains no commitments.

Please do not hesitate to contact me if there are any questions regarding this report.

Sincerely,

Robert M. Bellamy

DWE/dd
Enclosure: LER 2003-001-00

cc: Mr. Hubert J. Miller
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U.S. Nuclear Regulatory Commission
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1. NRC Form 366 U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

(See reverse for number of digits/characters for each block)

APPROVED BY OMB NO. 3150-0104

Estimated burden per response to comply with this mandatory information collection request: 50 hrs. Reported lessons learned are incorporated into the licensing process and fed back to industry. Forward comments regarding burden estimate to the Records Management Branch (T-6 F33), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, and to the Paperwork Reduction Project (3150-0104), Office of Management and Budget, Washington, DC 20503. If an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

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TITLE (4)

Manual Scram and Completion of a Required Shutdown due to Recirculation Motor-Generator Trip and Runback

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
									N/A	05000
02	21	2003	2003	001	00	04	17	2003	FACILITY NAME N/A	DOCKET NUMBER 05000

OPERATING MODE (9)	N	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR: (Check one or more) (11)							
POWER LEVEL (10)	22		20.2201(b)		22.2203(a)(3)(i)		50.73(a)(2)(i)(C)		50.73(a)(2)(vii)
			22.2202(d)		20.2203(a)(3)(ii)		50.73(a)(2)(ii)(A)		50.73(a)(2)(viii)(A)
			20.2203(a)(1)		20.2203(a)(4)		50.73(a)(2)(ii)(B)		50.73(a)(2)(viii)(B)
			20.2203(a)(2)(i)		50.36(3)(1)(i)(A)		50.73(a)(2)(iii)		50.73(a)(2)(ix)(A)
			20.2203(a)(2)(ii)		50.36(3)(1)(ii)(A)	X	50.73(a)(2)(iv)(A)		50.73(a)(2)(x)
			20.2203(a)(2)(iii)		50.36(c)(2)		50.73(a)(2)(v)(A)		73.71(a)(4)
			20.2203(a)(2)(iv)	X	50.46(a)(3)(ii)		50.73(a)(2)(v)(B)		73.71(a)(5)
			20.2203(a)(2)(v)		50.73(a)(2)(i)(A)		50.73(a)(2)(v)(C)		OTHER Specify in Abstract below or in NRC Form 366A
			20.2203(a)(2)(vi)		50.73(a)(2)(i)(B)		50.73(a)(2)(v)(D)		

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Bryan Ford – Licensing Manager	508-830-8403

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX
E	AD	MG	G080	Y					

SUPPLEMENTAL REPORT EXPECTED (14)			EXPECTED SUBMISSION DATE(15)	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE)	X	NO				

ABSTRACT (Limit to 1400 spaces, i e , approximately 15 single-spaced typewritten lines) (16)

On February 21, 2003 an unplanned manual reactor scram was initiated during a controlled shutdown while at 22% reactor power. The resulting scram was the completion of a required shutdown that was initiated as a result of a trip of the recirculation loop 'A' motor-generator (MG) set/pump on February 20, 2003.

The direct cause of the shutdown was the trip and lockout of the recirculation loop 'A' MG set/pump that was due to a mechanical-type failure of one of two rotor field slip ring copper studs on the generator portion of the MG set. The root cause was improper installation of the generator collector slip ring assembly in the 1991 timeframe. Corrective action taken included replacement of the loop 'A' MG set generator rotor and inspection and testing of the loop 'B' MG set generator.

The manual scram was directed as a result of a runback of the recirculation loop 'B' MG set/pump on February 21, 2003. The root cause of the runback was a difference between the actual total feedwater flow and the conditioned signal sent to the feedwater level control system. Corrective action taken included adjustments to improve the response of the feedwater regulating valves, and tuning the overall gain of the feedwater level control system.

The events posed no threat to public health and safety.

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BACKGROUND

The Pilgrim Station Boiling Water Reactor design includes a recirculation system that provides the drive flow of water to the jet pumps within the reactor vessel. The drive flow through the jet pumps is the impetus for driven flow in the reactor core. The Recirculation System includes two loops. Each loop is located inside primary containment and is external to the reactor vessel. Each external loop contains one variable-speed, motor-driven recirculation pump and two motor operated valves, one on the suction side and one on the discharge side of the pump. The pump motor is powered by the generator portion of the respective motor-generator (MG) set. It is possible to operate at reduced reactor power with one recirculation loop in operation.

The Pilgrim Station Facility Operating License Condition 3.E pertains to single recirculation loop operation and requires that while the reactor is operating, the plant shall be placed in a hot shutdown condition within 24 hours unless the loop (that is not operating) is sooner returned to service.

On February 20, 2003 at approximately 0525 hours, an unplanned trip and lockout of the recirculation loop 'A' MG set/pump occurred due to a loss of the electrical field of the generator portion of the MG set. The trip resulted in a loss of drive flow from the pump to the loop 'A' jet pumps, a reduction in total reactor core flow, and decrease in reactor power to about 65% reactor power. Plant operation continued with recirculation loop 'B' operating.

Initial utility licensed operator action was in accordance with training and procedures. This included closing of the loop 'A' pump discharge valve and reopening the valve after five minutes. In accordance with the procedure for a recirculation pump trip, reactor core flow was estimated at about 37E+06 pounds/hour with some reverse flow through the loop 'A' jet pumps. The neutron monitoring system average power range monitors (APRMs) are flow-biased for the high neutron flux trip function. The reverse flow through the loop 'A' jet pumps has a non-conservative affect on the flow-biased signals that are provided to the APRMs. Moreover, the APRMs are equipped with flow control trip reference features that were added as part of the Enhanced Option 1A stability solution for Pilgrim Station.

A 24-hour hot shutdown limiting condition for operation (LCO) was entered in accordance with License Condition 3.E (single loop operation). Plant operators were sent to investigate and noted no adverse conditions other than the tripped condition of the loop 'A' MG set field breaker and lockout relay. The loop 'B' MG set scoop tube was reset and the train 'A' feedwater regulating valve was placed in the manual control mode.

A reactor power reduction was subsequently initiated using control rods to limit reactor operation to less than the 67% load line on the reactor core power-flow relationship. This was not a required action but was taken as a conservative action to ensure plant operation would not potentially enter the restricted region of the power-flow relationship. The recirculation loop 'B' pump speed/flow was later decreased and this resulted in the expected decrease in reactor core flow. Reactor core flow was calculated at 35.5E+06 pounds/hour, at about 54% reactor power, by about 1540 hours.

Meanwhile, initial investigation determined the electrical lead from the recirculation loop 'A' MG set generator field-to-collector ring had failed. The timeframe for completion of the repair plan was estimated to potentially be three to four days. Consequently, preparations began for a verbal request to the NRC for enforcement discretion. The request was for additional time beyond the 24-hour requirement of License Condition 3.E. The request was made to the NRC on the afternoon of February 20, 2003. The request was denied.

On February 21, 2003 at 0025 hours, the initiation of the required plant shutdown began with the plant operating at about 39% reactor power. The shutdown was initiated after continuing investigation and troubleshooting activities concluded the loop 'A' MG set/pump could not be returned to service in the required timeframe. The NRC Operations Center was notified of the initiation of a required shutdown in accordance with 10 CFR 50.72 at 0228 hours on February 21, 2003.

The shutdown proceeded in accordance with the procedure for a controlled shutdown with one recirculation pump out of service. Continued monitoring of reactor core flow and recirculation flow indicated there was some reverse flow indication from the instrumentation that senses flow through the recirculation loop 'A' jet pumps.

At 0423 hours, while removing the feedwater heaters from service at 26% reactor power in accordance with the shutdown procedure, an unplanned automatic runback of the recirculation loop 'B' MG set/pump to the number 1 speed limit occurred. The runback resulted in a decrease in recirculation loop 'B' flow and consequent decrease in reactor core power and flow. The reactor core flow, estimated via manual calculation to account for reverse core flow was 14E+06 pounds/hour, and reactor power was 22%. By procedure, reactor operation is not allowed in the region of the core power-flow relationship with core flow at 14E+06 pounds/hour and 22% reactor power. The licensed shift manager requested Reactor Engineering to confirm core flow using the plant information computer (EPIC). Reactor Engineering reported the EPIC core flow indication was 17E+06 pounds/hour. Reactor operation is allowed with core flow at 17E+06 pounds/hour and 22% reactor power. Based on the runback, conflicting estimates of core flow, and the fact that a manual scram was previously planned at 26% reactor power, the licensed shift manager directed the licensed reactor operator to manually initiate a reactor scram.

EVENT DESCRIPTION

On February 21, 2003 at 0425 hours, the reactor protection system (RPS) was manually initiated while at 22% reactor power. This action was directed by the licensed shift manager and was accomplished by depressing the manual scram buttons located on the reactor control panel. The actuation of the RPS resulted in the expected insertion of the control rods. The insertion of the control rods completed the shutdown and resulted in a hot shutdown condition that was required because of the 24-hour limitation of License Condition 3.E for single recirculation loop operation.

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The scram resulted in the expected decrease in the reactor vessel water level, from +28 inches (narrow range level) to -4 inches (narrow range level). The decrease in reactor vessel water level to less than +12 inches resulted in the expected actuation of the Primary Containment Isolation Control System (PCIS) and Reactor Building Isolation Control System (RBIS). The actuations resulted in the following designed responses:

- The automatic closing of the Primary Containment System (PCS) Group 2/sample valves that were open and automatic closing of the PCS Group 6/Reactor Water Cleanup (RWCU) System isolation valves.

- The automatic closing of the Reactor Building ventilation supply and exhaust dampers and automatic start of the Standby Gas Treatment System.

Licensed operator response to the scram included the following. The reactor mode switch was moved from the RUN position to the SHUTDOWN position in accordance with the scram procedure. Procedure EOP-01, "RPV Control," was entered because the reactor vessel water level was less than +12 inches. EOP-02, "RPV Control, Failure to Scram," was subsequently entered because the initial position indication for several control rods did not indicate a fully inserted position. All control rods were verified fully inserted and EOP-02 was exited by 0428 hours.

EOP-01 was exited by 0443 hours when normal reactor vessel water level was established.

The RPS was reset. The PCIS and RBIS circuitry were subsequently reset. The RWCU System was returned to service, the SGTS was returned to standby service, and the Reactor Building ventilation dampers were reopened.

The NRC Operations Center was notified of the unplanned manual scram in accordance with 10 CFR 50.72 at 0810 hours on February 21, 2003.

CAUSE

The direct cause of the trip and lockout of the recirculation loop 'A' MG set/pump was a mechanical-type failure of one of the two rotor field slip ring ¼ inch copper studs. The root cause of the mechanical separation of the copper stud was improper installation of the MG set generator collector slip ring assembly. Contributing causes were inadequate oversight during the installation of the slip ring by a vendor (General Electric), in the 1991 timeframe, and lack of periodic meggar (insulation) testing and cleaning of the rotor. The lack of periodic insulation testing of the rotor and lack of periodic cleaning to remove carbon dust buildup on the rotor contributed more to the extent of the damage inside the rotor, rather than initiating the failure. The failure was classified as a Maintenance Rule failure. The failed rotor was part of the MG set generator, manufactured by General Electric, model 5ATB861072A2, type ATB.

The direct cause of the unplanned manual scram was the depressing of the manual scram buttons on the reactor control panel. This action was directed by the licensed shift manager as a result of the unplanned automatic runback of the recirculation loop 'B' MG set/pump and conflicting indications that the resultant core flow may be in the region of the reactor power-flow relationship where reactor operation is prohibited at 22% reactor power. During the post-trip review of the event it was found that as a result of the recirculation loop 'B' runback, the reactor was actually operating at 16-17E+06 pounds/hour and 22% reactor power. These conditions mean the reactor was actually operating in the monitored region of the reactor core power-flow relationship, not in the prohibited region.

The root cause of the runback of the recirculation loop 'B' MG set/pump was the difference between the actual total feedwater flow and the conditioned signals sent to the feedwater level control system for display on the feedwater flow recorder FR-640-26 and the recirculation runback alarm unit 640-17B. The difference is more apparent at low power operation. The actual feedwater flow indicated by the plant process computer (for core thermal power) is conditioned digitally while the signals to the runback alarm unit 640-17B and flow recorder FR-640-26 are conditioned analog signals. After the event, the automatic runback of the MG set/pump was evaluated. The evaluation concluded the runback occurred as designed and was due to the analog instrumentation loops that erroneously sensed feedwater flow less than 20% for a short period just prior to the runback. A recirculation MG set/pump runback at less than 20% of rated feedwater flow, or recirculation pump discharge valve not fully open, is a feature that functions to protect a recirculation pump from cavitation. A contributing cause was feedwater flow harmonics induced by the feedwater regulating valves.

CORRECTIVE ACTION

Regarding the recirculation loop 'A' MG set generator rotor failure, significant corrective actions taken or planned include the following:

- The loop 'A' MG set generator rotor was replaced with a new rotor, and the loop 'A' MG set generator stator windings were cleaned.
- The loop 'B' MG set collector ring assembly and associated wiring were visually inspected, and the loop 'B' MG set generator stator and rotor field were tested.
- Guidance to install a collector ring assembly will be obtained. The focus of this action is to develop appropriate guidance for the installation of a collector ring to ensure that collector ring stud bending and the installation of a collector ring assembly onto the rotor shaft is performed without damaging the electrical leads.
- A non-destructive method will be explored for inspecting the recirculation loop 'B' MG set during the 2003 refueling outage. The focus of this action is to determine the structural integrity of the generator collector ring studs.
- Additional periodic inspections, cleaning and testing of the recirculation MG sets' generator stator and rotor assembly will be evaluated. The focus of this action is to determine if additional periodic maintenance is required and if required, to create additional periodic preventive maintenance tasks.

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Regarding the unplanned manual scram, corrective actions taken or planned include the following:

- The gain of the gain springs of the positioners of the feedwater trains 'A' and 'B' regulating valves were adjusted. The air volume boosters of the feedwater trains 'A' and 'B' were adjusted. The focus of these actions was to improve the response of the valves. The overall gain of the feedwater level control system was checked and tuned. These three activities were previously scheduled and their completion while shut down improved the overall response to the system and should improve the feedwater flow harmonics (contributing cause).

- Any abnormalities during calibrations of feedwater loop instruments during the 2003 refueling outage will be investigated. The focus of this action is to evaluate and conduct a calibration/response check of feedwater loop instruments.

- The instrumentation that provides total feedwater flow measurement will be investigated. The focus of this action is to determine if total feedwater flow measurement at low flow rates can be improved or if it is feasible to provide the recirculation MG set/pump runback signal from the plant information computer (EPIC).

- The shutdown procedure will be revised to add additional guidance during single recirculation pump operation based on the lessons learned from the event.

- The event will be included in the operator training program.

SAFETY CONSEQUENCES

The trip of the recirculation loop 'A' MG set/pump 'A' on February 20, 2003 and subsequent operation with only one recirculation pump in operation posed no threat to public health and safety for the following reasons:

A trip of a recirculation MG set/pump at 100% reactor power and 100% core flow is an analyzed transient (UFSAR Appendices G and R).

Operation with only one recirculation pump in operation (single-loop) has been analyzed to determine the core operating limits using the analytical methods previously reviewed and approved by the NRC in Technical Specification 5.6.5.b.1 and specifically described in General Electric (GE) report NEDE-24011-P-A, "General Electric Standard Application for Reactor Fuel."

The APRM high neutron flux scram clamp function is not affected by single recirculation loop operation.

The neutron monitoring system local power range monitors (LPRMs) are spatially located throughout the reactor core to detect neutron conditions. The LPRMs are not affected by single recirculation loop operation because the LPRMs do not receive a flow-bias signal. The LPRMs input to the Period Based Detection System (PBDS). The PBDS was operable and is independent of the APRM flow-biased scram and rod block functions. The PBDS functions to alert operators of the onset of a thermal-hydraulic instability condition. Operator training and procedures require the initiation of a manual scram if an instability condition had occurred.

The stresses are acceptable on the recirculation loops' jet pumps during single recirculation loop operation.

The manual scram posed no threat to public health and safety. The actuation of the RPS was the designed response to depressing the manual scram buttons. There were no other adverse consequences due to the difference between the actual feedwater flow and the conditioned signals sent to the feedwater level control system.

REPORTABILITY

This report was submitted in accordance with 10 CFR 50.73(a)(2)(i)(A) because of the completion of a required shutdown.

This report was also submitted in accordance with 10 CFR 50.73(a)(2)(iv) because the plant conditions that resulted in the decision to initiate the manual scram were not planned.

SIMILARITY TO PREVIOUS EVENTS

A review for similarity was conducted of Pilgrim Station Licensee Event Reports (LERs) submitted to the NRC. The review focused on LERs involving a similar trip or cause involving a recirculation MG set/pump. The review identified no similar event.

A review for similarity was also conducted of Pilgrim Station LERs submitted to the NRC. The review focused on LERs involving a similar unplanned manual scram or cause. The review identified no similar event.

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ENERGY INDUSTRY IDENTIFICATION SYSTEM (EIIS) CODES

The EIIS codes for this report are as follows:

COMPONENTS	CODES
Alarm	ALM
Computer	CPU
Generator Set, Motor	MG
Pump	P
Recorder, flow	FR

SYSTEMS

Engineered Safety Features Actuation System (RPS, PCIS, RBIS)	JE
Feedwater Level Control System	JB
Incore/Excore Monitoring System	IG
Reactor Recirculation System	AD